FINAL TECHEVAL

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TACTICAL ENVIRONMENTAL SUPPORT SYSTEM (TESS(3))
DEVELOPMENTAL TEST REPORT DISTRIBUTION

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The Tactical Environmental Support System (TESS(3)) provides results of Technical Evaluation 18 June - 12 July 1990, Engineering Development Model #3 (EDM#3), installed at the Naval Eastern Oceanography Center, Norfolk,VA and EDM#4, installed aboard USS THEODORE ROOSEVELT (CVN 71) were evaluated.

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TESS(3)

MEMORANDUM 30 July 1990

From : TESS(3) Development Test Director
To: Commander, Naval Space and Warfare Systems Command (PMW-141)

Via: Commanding Officer, Naval Eastern Oceanography Center

Subj: REPORT OF DEVELOPMENT TESTING FOR THE TACTICAL ENVIRONMENTAL SUPPORT SYSTEM (TESS(3))

Encl: (1) Report of results from Development Test IIA (DT-IIA)
(2) Report of results from DT-IIB

1. Purpose. Development Test II was conducted to support a Milestone III production and deployment decision. DT-II consisted of DT-IIA for TESS(3) ashore, DT-IIA for SMOOS and a combined TESS(3)/SMOOS DT-IIB for units afloat. SMOOS DT-IIB will continue through 17 November 1990.

2. Equipment/System Description. The TESS(3) is a computer based environmental data processing, communications and display system to be installed in selected Navy combatant ships and command centers ashore. SMOOS is a suite of environmental sensors that will be installed aboard those same ships and interfaced with TESS(3). EDM #3 was installed aboard the Naval Eastern Oceanography Center for the conduct of DT-IIA and for support of EDM #4 aboard USS Theodore Roosevelt during DT-IIB. (KR) C

3. Background. The TESS(3) / SMOOS combination was developed to provide Navy Tactical Commanders ashore and afloat with secure, responsive, and robust environmental support, including quantification and display of environmental satellite data. The aim is to enable Tactical Commanders to employ environmental understanding as a force multiplier in all aspects of naval warfare. TESS(3), through various interfaces will: provide graphical data via overlays to tactical C3I systems; provide digital data as input to tactical decision aids: and provide output of 32 proven applications (models) to operational users now and additional applications later.

4. Scope. Development Test objectives were all geared towards assessing the ability of TESS(3) to enhance warfighting capabilities. Enclosure 1 contains test objectives, limitations to scope, evaluation criteria and results from DT-IIA. Enclosure (2) contains the same information pertaining to DT-IIB.

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5. Remarks. Testing was both thorough and conclusive. We tested TESS(3) in a high OPTEMPO at sea environment. In doing so, machine performance was much more critical than in tests ashore. In fact, a judgement of suitability of TESS(3) should be made based on results from testing at sea, even though TESS(3) will be placed at shore sites. Will TESS(3) add to the operational commanders warfighting capabilities Our testing reveals that it will, given the correction of these major discrepancies:

(a) System performance with regard to hangups must be improved dramatically. The operator should feel confident that any task he gives the machine will be finished the first time. There is n time for rerunning applications at sea.

(b) The interface with the SMQ-11 must be fixed such that, with rare exception, all satellite passes are ingested properly into TESS(3). Satellite data is critical to the OA division ability to provide proper support.

(c) All rehosted applications programs must work correctly. Thes programs are the backbone to the TESS concept.

(d) The CCTV interface is critical to support as well. The interference problem must be resolved as must the issue of properly displaying enhanced satellite images.

6. Conclusion. TESS(3) testing proved that the machine will have a positive impact on our ability to support the operational commander. Certainly, current plans for continued upgrade of TESS(3) will make it even more valuable with time. However, as stated in paragraph 5, TESS(3) has some critical flaws. These flaws must be fixed if we are to demonstrate operational usefulness.

7. Recommendations. Prioritize our discrepancies for correction by Lockheed prior to DT-IIC. The four discrepancies listed in paragraph (5) should be given the highest priorities. Continue with plans to conduct DT-IIC on 21 and 22 August. Depending on USS Theodore Roosevelt availability, conduct the testing on both EDM #3 and EDM #4. During DT-IIC test against all known critical discrepancies. Determine readiness for OPEVAL after final testing.

, LCDR USN

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Enclosure (1)

DEVELOPMENT TEST IIA
FOR THE TACTICAL ENVIRONMENTAL SUPPORT SYSTEM (TESS(3))

SYSTEM: TESS(3) (AN/UMK-3)
DT PHASE: DT-IIA

1. Test Conduct. DT-IIA was conducted from 25 Apr 1990 through 18 May 1990 at the Naval Eastern Oceanography Center, Norfolk Va. The test was conducted using personnel from NAVEASTOCEANCEN, NAVELEXSYSENGCEN Vallejo, NOARL W and COMSPAWARSYSCOM (PMW-141).

As this was the first field testing of TESS(3), we conducted a structured test in accordance with NAVELEXSYSENGCEN Vallejo document 14203-0336959. Utilizing operators trained at Lockheed in Austin, Texas, test conductors ran the machine through its paces in an attempt to find as many problems as possible. Both "low tempo" and "high tempo" scenarios were run, in addition to the basic computer functions. These scenarios were repeated later in DT-IIB.

When complete, we generated many discrepancy reports, and kept track of system performance. Communications interfaces were monitored carefully throughout the test.

2. Scope.

a. Objectives. DT-IIA objectives were generally geared towards testing the machines ability to perform the functions at a shore site, however, at sea scenarios were also run. As such, we:

(1) Tested rehosted, approved, Navy Standard Applications Programs and Data Bases against their Test Specifications and the constraints of the Contract Specification.

(2) Tested all contractor supplied NDI and developed software, including the three-dimensional data base, against comprehensive test plans.

(3) Assessed the AN/SMQ-11 interface and receipt and processing of real-time environmental satellite data from NOAA, DMSP and GOES WEFAX, and category IV applications programs.

(4) Assessed the processing of near real-time environmental data from sources other than SMQ-11 (e.g., RATT, MEDS, etc.).

(5) Assessed the data base management functions as described in

the contract specifications.

(6) Assessed the display functions as prescribed by the Contract Specification.

(7) Assessed the adequacy of contractor operator training and the self help training as prescribed in the TESS(3) FSED Statement of Work.

(8) Assessed the adequacy of contractor computer security, TEMPEST and E3 testing and certification.

(9) Assessed system readiness to begin TECHEVAL.

b. <u>Evaluation Criteria.</u> Para 2.b.(1) applies to para 1.a.(1), 2.b.(2) applies to 1.a.(2), etc..

(1) Simply, rehosted software must perform exactly as it would in TESS 2.0.

(2) All software must perform as expected, based on documentation and training received. Data residing in the data base must be available to all software that requires it and the retrievals should be quick enough so as not to interfere with operational capabilities. Data should remain in the data base until the end of its useful life. Manual purging of the data should be simple and efficient.

(3) TESS(3) should ingest all passes scheduled. Data ingest should occur in the background and have no effect on system usage other than perhaps a slight slowing down of processes due to the large data ingest. Imagery should overlay properly on a geographical background of choice. The operator should be able to choose enhancements for extracting meteorological or oceanographic features. Data should be stored on disk such that consecutive images are available in the system for merging.

(4) See evaluation criteria for objective . of the OT-IIB phase.

(5) See evaluation criteria for objective 1 of the OT-IIB phase.

(6) The graphics interface should be readily usable and easy to learn by the typical fleet Aerographers Mate. Displays must be clear and concise. Graphics displays rehosted from TESS 2.0 should be faithfully recreated.

(7) Lockheed conducted three training sessions in Austin, Texas. All personnel assigned to Dt-IIA were trained at Lockheed. In addition, some of those personnel trained by the contractor were to train additional personnel at NAVEASTOCEANCEN, using training materials provided by the contractor.

8) Tested at Lockheed, Austin, prior to DT-IIA.

(9) Computer security was tested by NESSEC, and was reported separately. A TEMPEST check was requested, but was not conducted as part of DT-IIA.

(10) A team of Lockheed, NAVELEXSYSENGCEN and NOARL W personnel were to conduct Acceptance testing and Installation and Check out procedures aboard USS Theodore Roosevelt.

c. <u>Results.</u>

(1) See results of objective 3 for DT-IIB.

(2) The test plan was comprehensive enough to thoroughly test all software. In general, software worked as expected, although there were several discrepancy reports generated on software that was contractor supplied. All discrepancy reports were subsequently prioritized and turned over to Lockheed for correction. The three-dimensional data base worked quite well with only minor exceptions. The ability to add data to, and purge data from, the data-base were thoroughly tested and successful.

(3) Problems with the SMQ-11 interface plagued us through testing. The failure to ingest satellite passes routinely, the automatic disabling of the interface, and other problems, caused this interface to be unreliable. Generally, once the image was received by TESS(3); storage, retrieval, display and manipulation worked as expected with minor exceptions. We were also successful in overlaying imagery with gridded fields and raw data plots. This ability to overlay worked well and is critical to successful TESS(3) .

(4) See results of objective 1 in DT-IIB phase.

(5) See results of objective 2 in DT-IIB phase.

(6) TESS(3) graphics MMI met all our requirements. Given the complexity of the system, the display functions were easy

to follow.

(7) In general, Navy students were displeased with the quality of training received at Lockheed. The training aids were inadequate, and the instructors ill-prepared. The Navy personnel charged with conducting follow on training were not given quality instructional aids. DT-IIA operators were successful because they were senior personnel who spent much off time learning the system.

(8) Performed at Lockheed, Austin, prior to DT-IIA.

(9) See comments under evaluation criteria above.

(10) EDM #4 was installed, and successfully acceptance tested aboard USS Theodore Roosevelt.

enclosure (2)

DEVELOPMENT TEST IIB
FOR THE TACTICAL ENVIRONMENTAL SUPPORT SYSTEM (TESS(3))

SYSTEM: TESS(3) (AN/UMK-3)
DT PHASE: DT-IIB

1. Test Conduct. DT-IIB was conducted around the clock from 18 June 1990 through 12 July 1990 aboard USS Theodore Roosevelt. The ship was at sea during testing except for a short port visit from 1 through 5 June. Testing was done in two phases. The first, covering the period 18 June thru 2 July, was spent executing formal Development Test procedures as specified in NAVELEXSYSENGCEN Vallejo document 14203-0336959. Our intention during this phase was to load the system down as much as possible and identify problem areas in both hardware and software. We also monitored system performance. In addition to basic tests, we introduced both "low tempo" and "high tempo" scenarios. Approximately 75 low tempo and 15 high tempo scenarios were executed. These covered a broad spectrum of warfare areas, including AAW, ASW, ASUW, EW and AMW. High tempo scenarios were designed to support multiple warfare areas simultaneously.

Phase 2 of DT-IIB allowed observers to monitor system performance in supporting live operations. Since the ship was in "advance phase", we were operating in a high tempo warfighting environment. Phase 2 culminated in a three day "hostilities phase". During the 48 hours preceding hostilities phase, TESS(3) was used extensively for mission planning.

2. Scope.

a. Objectives. Development Test objectives were all geared towards assessing the ability of TESS(3) to enhance warfighting capabilities. As such, test the TESS(3) capability to:

(1) Test all data sources ensuring the logical and timely assimilation of data to the appropriate data files. Data sources include:

(a) Indigenous RATT
(b) Channel 8/15 of the Fleet Broadcast
(c) DMSP, NOAA, GOES WEFAX
(d) Available environmental sensors
(e) Available SMOOS sensors
(f) Manual entry

(g) NOC data fields

(2) Test the database management functions for the complete life cycle of all data stated above.

(3) Exercise all applications programs extensively.

(4) Evaluate the flexibility of TESS(3) to meet diverse requirements with degraded input data, loss of components, interfaces and interfacing systems.

(5) Test the background and live brief capability of the CCTV interface.

(6) Test the hardcopy capability.

(7) Demonstrate the adequacy of the following TESS(3) requirements:

(a) Characteristics (performance, reliability, maintainability, availability, etc)

(b) Design and construction

(c) Documentation

(d) Logistics

(e) Personnel and training

(8) Demonstrate that TESS(3) OPEVAL certification requirements are met.

b. Evaluation Criteria. Para 2.b.(1) applies to para 2.a.(1), 2.b.(2) applies to 2.a.(2), etc,.

(1) Raw data ingest is the key to TESS(3)s ability to support fleet requirements. TESS(3) afloat must be able to simultaneously ingest data from several sources. The current design contains protocol to receive data from radio-teletype broadcasts and Channel 8 of the fleet broadcast (environmental data). It also has the ability to receive data through Fleet Satellite Communications (FLTSATCOM). These are the primary shore based sources of data. User ability to access all available data sources on a world wide basis requires a system that allows software manipulation of the communications protocols, such that baud rate, parity, etc., can be adjusted to meet current circumstances. Data ingest must also occur in the background such that these operations are transparent to the user and have little or no effect on system performance. In situ data from the SMQ-11, and SMOOS sensors must be able to be ingested routinely and without constant monitoring.

(2) Although environmental data is perishable it must reside in the computer for specified periods. Mass storage devices, in particular the disks, must have enough capacity to allow for storage of all the data mentioned in the preceding paragraph. Additionally, data retrieval must be fast enough so as not to negatively impact operations. All data must be available for the rehosted applications programs and new TESS(3) software. TESS(3) is interfaced with the SMQ-11 satellite receiver. It

must display images received on a specified geographical background and be able to overlay both raw data reports and output from computer models received from shore sites on that same background. There must be sufficient storage to hold successive satellite images to allow for coverage of a large geographic area.

(3) In handling the data, TESS(3) uses software rehosted from the existing TESS 2.Ø software library in addition to newly developed and commercial software. TESS 2.Ø software is part of the Geophysics Fleet Mission Planning Library (GFMPL) which has been thoroughly tested and accepted. The TESS(3) rehosted version must perform exactly as the original and all new software should perform as required by specifications.

(4) TESS(3) must be robust enough to support operations despite loss of ancillary equipment. Loss of a workstation should not, for example, result in an inability to provide support. In addition, the storage capability should be such that data is maintained long enough to allow for some continued operation after data sources are lost. This reliance on older data, combined with local observations should allow for the continued output of quality products for a reasonable period of time. There should be a fallback position for loss of communications interfaces. For example, loss of the SMQ-11 interface should never result in loss of satellite data, only the inability to transfer the image to TESS(3).

(5) As a display device, TESS(3) must routinely provide graphics output to the CCTV. Virtually any product available to TESS(3) should be available as a CCTV display. The display must run both as a background process and foreground process for live briefs. The CCTV image must be clear and free from interference. The time necessary for creation of CCTV images should not be excessive.

(6) While TESS(3) is not designed to output to hardcopy primarily, there are instances when printer output is necessary. Printer output should be clear, with good black/white contrast. The output should occur within a reasonable time so as not to result in a long wait status at the terminal initiating the printout. The printer should be capable of a faithful representation of shades of gray for satellite images, and black lines on a white background for all other printouts.

(7) TESS(3) will be the only computer onboard capable of producing a myriad of essential products which add to the Commanders ability to fight a war. It is therefore absolutely

essential that TESS(3) hardware be capable of running around the clock. While occasional outages are expected, TESS(3) must fail only infrequently in accordance with specifications and must be maintainable by a trained fleet Electronics Technician. Sufficient spares must be maintained onboard. In addition, the system and applications software must run without failing. Execution of software should not terminate abnormally due to terminal or system wide hangups. Operational and maintenance procedures must be documented. TESS(3) will be operated primarily by Aerographers Mates, of all ranks, with varying computer backgrounds. The wide range of options available makes a simple menu driven system necessary. In addition, the user interface must be generally consistent to allow for rapid learning of the system. OJT must be easily accomplished.

c. Limitations to Scope. Evaluation of TESS(3) ability to receive queries from or provide data to other onboard computer systems was not tested due to the non availability of these systems during the Techeval time frame. These systems include the FDDS and NAVMACS.

d. Results.

(1) Objective 1, the ingest of data from all available sources, tested as follows:

- Channel 8 of the Fleet Multi-Channel broadcast appeared flawless.
- Foreign Radio Teletype was tested using the Halifax, Nova Scotia broadcast. No problems were observed.
- SMQ-11 Satellite image ingest was marginally successful. With great attention to detail, we were successful approximately 50 percent of the time in receiving images from NOAA satellites, while we had a 20 percent success rate with DMSP passes. These results are unacceptable from an operational standpoint and must be corrected.
- The ingest of data from SMOOS sensors appeared to work well provided the sensors themselves were performing correctly. There were occasional problems with the SMOOS output display showing up on the wrong terminal. This was written up as a discrepancy report.
- We experienced no problems with manual entry of data.
- DAMA satellite receipt of numerical gridded fields from the shore site was marginally successful. We learned, prior to Techeval that our 300 baud DAMA circuit was prone to communications errors in the form of dropped bits of data. Thus, the shorter the transmission, the greater the likelihood of success in receiving the data. Additionally, TESS(3) protocol does not, at this time, allow for errors in the receipt of gridded fields. Fields received with

error are discarded by the computer. Successful receipt of gridded fields was hit and miss. Low resolution fields (32 x 32), which took 3 minutes to transmit, were ingested successfully far more frequently than the medium resolution fields (64 x 64), which took 10 minutes to transmit. If the DAMA was particularly "clean" we received up to 75 percent of the small grids sent from ashore. However, that might be followed by a zero percent success rate. Medium grid fields were never received with a success rate exceeding 20 percent. Clearly, a more robust methodology must be employed for production.

All data input occured in the background, requiring no operator intervention. Receipt and processing of large amounts of data do appear to slow the system down noticeably, as might be expected. However, the system slow down was not of operational significance.

(2) Objective 2 concerns capacity of mass storage devices and data base management functions. Storage capacity appears satisfactory. Retrieval time is dependent upon the amount of data being transferred and the current utilization of the computer. Retrieval time did not negatively effect operational capabilities. All data was available across the range of programs. Environmental data is perishable but must remain in the system for its useful life. TESS(3) retained data for the requisite period.

(3) Objective 3 concerns the quality of the rehosted applications software and newly developed software. Several Software Trouble Reports (STRs) have been written against the latest software. Most of these STRs are written against newly developed software, but some critical ones identify problems with rehosted applications. The operational impact, particularly of the faulty rehosted software, is great. All of the problems with the rehosted software should be corrected prior to OPEVAL. The remaining problems have been prioritized and the critical ones should also be corrected prior to OPEVAL. Of these, the software required for proper ingest of satellite data from the SMQ-11 is of key importance.

(4) Objective 4 relates to the computers ability to support operations despite the loss of data, ancillary equipment or interfaces. During testing these losses occured naturally. We operated without a workstation during the first phase, suffered a loss of data from the Fleet Broadcast on occasion and received little data from the DAMA circuit. The SMQ-11 interface also caused some problems. TESS(3) is a capable machine and handled the loss of a workstation well. In fact, except for the obvious fact that one less user had access to the computer, the loss of terminal(s) is transparent to the other users. The storage of data allows TESS(3) to continue to support users for a given

period of time after the loss of data circuits. As might be expected, after 24 to 36 hours, the loss of data would have a significant impact on TESS(3). There is, with the ability to enter in situ data through the keyboard, much that TESS(3) can continue to accomplish despite the loss of data cicuits. The key interface problem occured with the SMQ-11. This did not preclude obtaining satellite imagery, but rather the TESS(3) ability to receive it. The SMQ-11 worked perfectly fine in a stand alone mode.

(5) Objective 5 concerned the CCTV interface. The interface worked well with the following exceptions:

- Some interference is present in the CCTV display. Although the display is in no way obsured, the interference does catch your attention and must be eliminated.
- Satellite images typically have to be enhanced to bring out detail. This enhancement does not properly translate to the CCTV display. This should be fixed prior to OPEVAL so that TESS(3) capabilities with regard to CCTV can be fully demonstrated.
- Time required to make a CCTV display is excessive. The process should be streamlined for production models.

(6) Objective 6 discussed the hardcopy capability. The TESS(3) image printer puts out a high quality copy. Problems noted are as follows:

- Time to print, measured from the time the final command is given, is excessive. This should be addressed for production models.
- All non satellite image output should be as we are accustomed to seeing it, with black lines on a white background. Currently, only application programs output black on white. The remainder use a white line on black background scheme. This should be addressed prior to production.

(7) Objective 7 deals in general with system performance. The critical computer hardware has yet to fail, so we have no specific figures for MTBF. During Techeval, two minor hardware failures, which were not repairable by the ET, resulted in some terminal down time. A complete set of spares is necessary aboard ship. Probably the most disappointing aspect of TESS(3) performance aboard ship was the number of terminal hangups. Invariably, these hangups result in failure of programs to complete. In a high OPTEMPO environment, the result is devastating. These hangups severely limit the operational usefulness of the machine. TESS(3) is generally well designed and safe to use. Two discrepancies were written regarding minor design flaws which made access to some gear and cables

difficult. Documentation for the maintainer and operator appear thorough.

(8) Objective 8 discusses TESS(3) OPEVAL certification requirements. This is discussed in the final paragraphs of the basic letter.